

Synthetic Transportation Fuels

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DESC Worldwide Energy Conference
Arlington, VA
29 September 2004

Overview

- What are synthetic fuels
- World programs
- US programs
- Technical benefits
- Summary statements



Synthetic Fuels

- Most transportation fuel comes from petroleum
 - Liquid hydrocarbons with desirable properties
- Alternate sources of hydrocarbons
 - Shale oil:
 - Extraction of heavy tar from rock very expensive
 - Tar sands
 - Some current production in Canada
 - Coal
 - Liquifaction: expensive and requires a lot of hydrogen
 - Gasification
 - Biomass gasification
 - Natural gas



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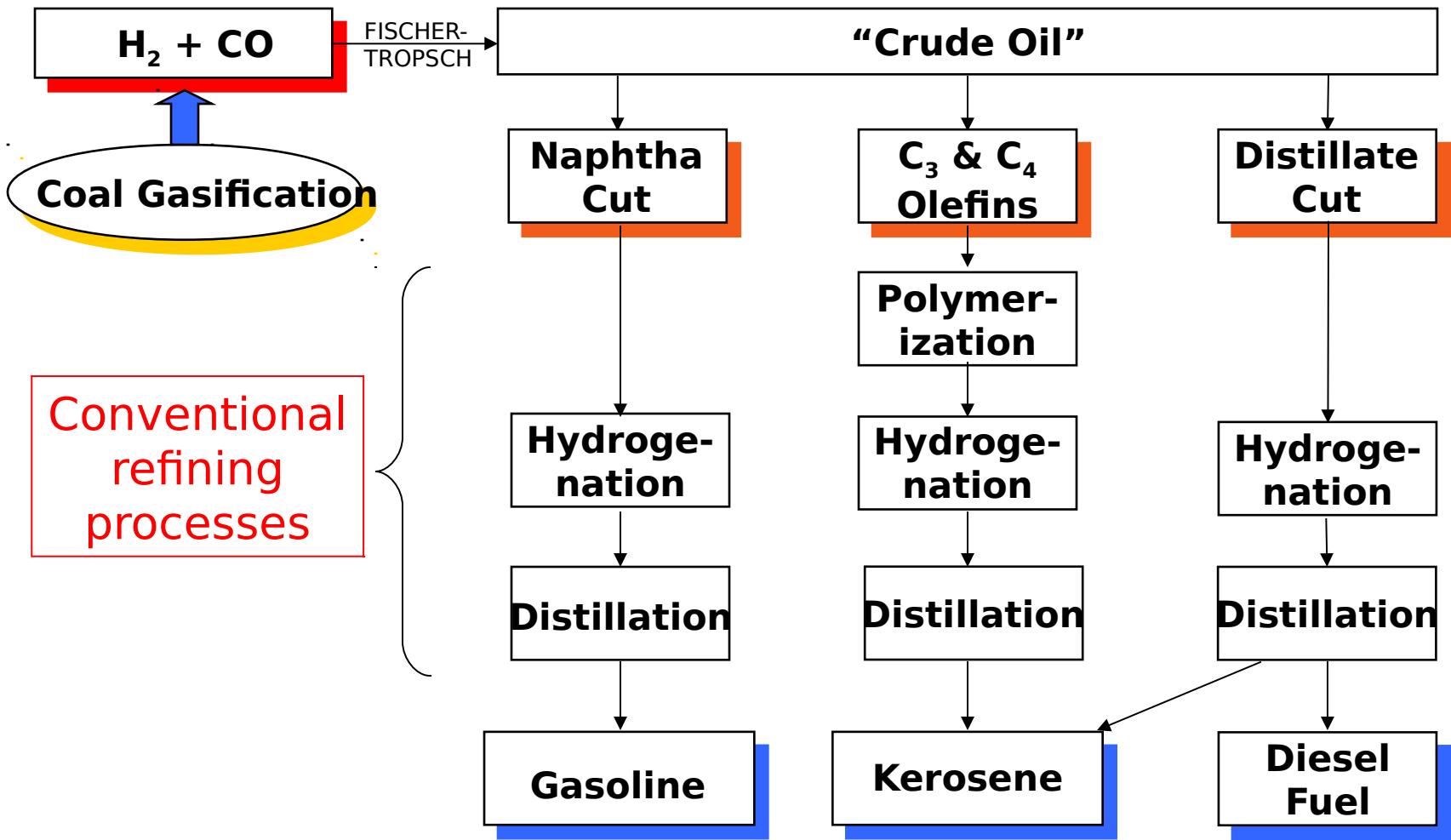


Synthetic Fuels

- Hydrocarbon molecules in the fuel are synthesized from hydrogen (H_2) and carbon monoxide (CO)
 - Fischer-Tropsch processes developed by Germans during WW II to make gasoline from coal
 - Modernized in South Africa by Sasol during apartheid
- Resource can be any burnable material
 - Coal
 - Biomass
 - Natural gas
- Combustion is done with limited air to yield CO and H_2 rather than CO_2 and H_2O
- $CO + H_2 \longrightarrow$ Fuel molecules by the magic of catalytic chemistry



Sasol Processes for Synthetic Fuels



Synthetic Fuel Projects

South Africa

- Sasol (coal): 160,000 BPD
 - Began making synthetic gasoline and diesel in late 1950's
 - Semi-synthetic jet fuel started in 1999 (50% blend)
 - Approval of fully synthetic jet fuel under review by UK Aviation fuels Committee (Def Stan 91-91)
- MossGas (natural gas): 22,500 BPD

Malaysia

- Shell (natural gas): 15,000 BPD
 - Synthetic hydrocarbons primarily for solvents



Projected Growth



F-T Projects in U.S.

- **BP**
 - **Nikiski, AK**
 - **300 bpd demo plant (natural gas-fed)**
 - **FT reactor product sent to near-by refinery**
- **ConocoPhillips**
 - **Ponca City, OK**
 - **400 bpd demo plant (natural gas-fed)**
 - **Just starting up**
- **Syntroleum**
 - **Tulsa, OK**
 - **70 bpd demo plant (natural gas-fed); DoE co-sponsor**
 - **2002 start-up**
- **Rentech**
 - **East Dubuque, IL**
 - **Convert natural gas-fed fertilizer plant to use coal**
 - **Co-produce FT fuels, fertilizer, and electricity**
- **Waste Management and Processors Inc. (WMPI)**
 - **Gilberton, PA**
 - **5000 bpd demo plant (gasification of coal wastes)**
 - **DoE co-sponsor**



DoD Evaluation of F-T Fuels

- DoD-DoE Joint Agency Program
- Started evaluations in FY03
- Define FT jet fuel formulations needed to allow use in all DoD equipment
- FT jet fuel supplied by Syntroleum Corp. from Tulsa demonstration plant
- Presenting under FAS Track-Synthetic Fuels at 1600-1650 TODAY (09-29-04)



Benefits

- Energy security
 - Increase use of domestic energy resources
 - Increase pool of countries with fuel resources
- Fuel quality
 - Lower particulate emissions
 - Diesel: Higher cetane number
 - Jet: Lower aromatics
 - Zero sulfur
 - Longer combustor life
 - lower flame radiation and liner temperatures
 - Better thermal stability



Problems

- Diesel fuel
 - Low lubricity -- use additives
- Jet fuel
 - Low lubricity -- use additives
 - Zero aromatics
 - Materials compatibility issues
- Issues are solvable
 - Start with blends
 - Progress to fully synthetic
- Goal is to be transparent to the user



Summary

- Energy security
 - Increase use of domestic resources
 - Increase the number of countries producing fuel
- Better fuel quality
- Very limited use in US in next ten years
 - Transparent to user
 - Semi-synthetic blends
 - Fully synthetic

